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Proposal on a

Ground Data Handling System

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INTRODUCTION

Maximum exploitation of any data collection system requires a thorough knowledge of the using agencies requirements, existing techniques and existing equipments. For economic reasons as well as operational ones, the use of multi-purpose equipment is usually desirable. In some cases, however, the uniqueness of the data collection instrumentation may require highly specialized data reduction tools. Moreover, pressure of time may limit the accuracies achievable. The fact that a specific collection device has not as yet been demonstrated, predisposes the customer to proceed with caution in acquiring a ground data handling system. Fully appreciating the validity of these reasons, Itek Corporation has consequently prepared this proposal for a minimum exploitation capability with provisions for expanding it into a maximum exploitation system after the initial data collection system and data handling system have proven to be of significant value. To accomplish this, Itek recommends a three phase program.

APPROACH

After several conferences with the using agency, a specific set of instruments have been agreed to for an initial capability. Furthermore, agreements have been reached as to the developments that should be undertaken to provide the maximum exploitation capability. In the latter case, however, specific design parameters have not as yet been determined. Accordingly, a reasonable program would consist of:

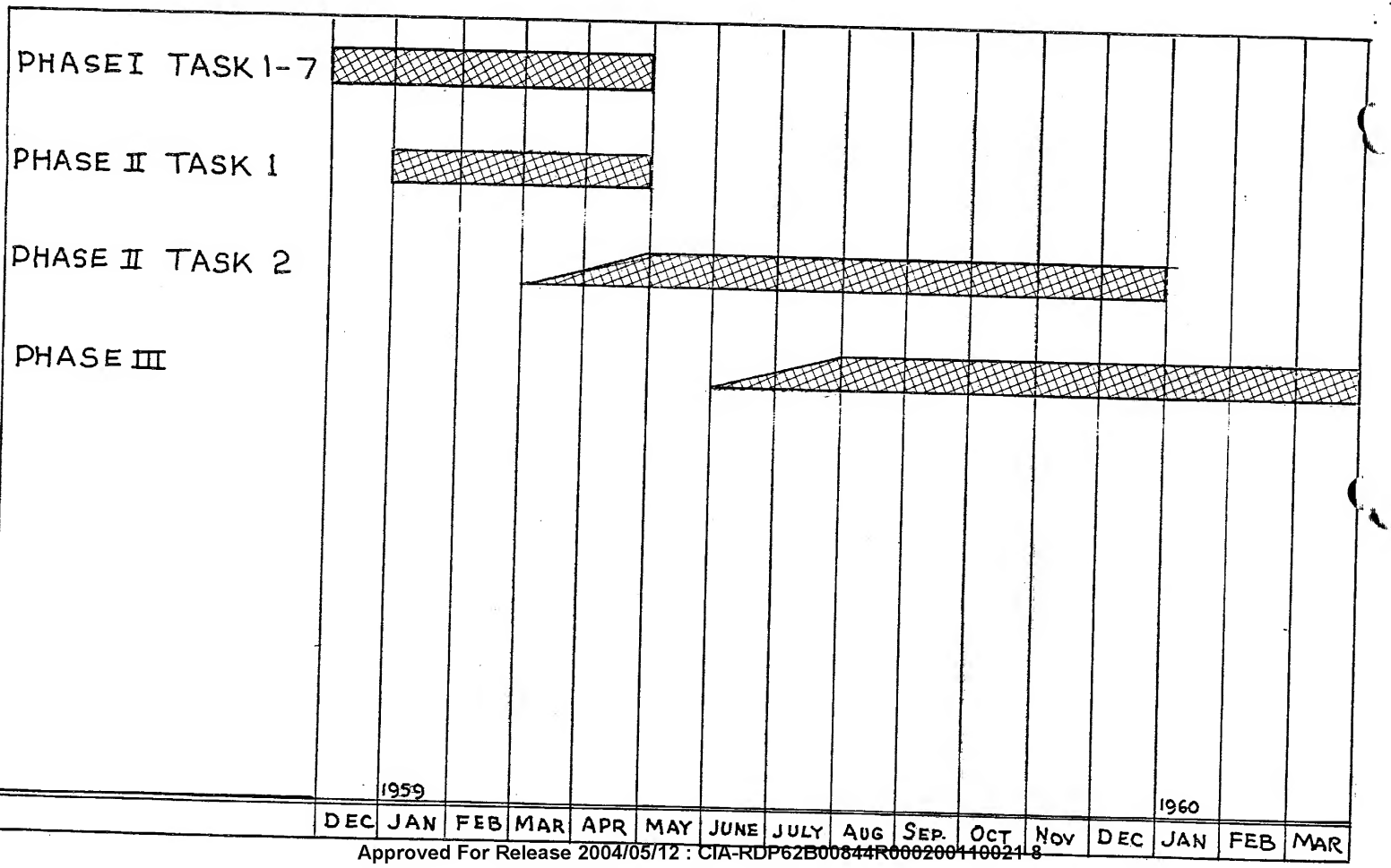
Phase I - Design, and prototype fabrication of an immediate capability.

Phase II - Study, design and prototype fabrication of a maximum capability.

Phase III - Production of final equipment.

PROJECT SCHEDULE

GROUND HANDLING SYSTEM



. FIGURE 1.

In order to minimize delays in providing the maximum capability, some overlapping of the three phases is essential. The proposed schedule is illustrated in Figure I.

Phase I - Design and Prototype Fabrication for Immediate Capability

The object of Phase I is to satisfy the immediate exploitation requirement within a definite time period as indicated in Figure I. Agreement was reached with the Using Agency as to the various equipments required. Some of these equipments, with suitable modifications, were developed on the 461-L Ground Handling Program. Several are entirely new. Also, in order for the Phase I exploitation to be complete, several equipments possessed by the Using Agency must be programmed and incorporated into the overall exploitation system. Itek will supply the necessary information and services for this purpose.

The equipments supplied by Itek will be: an Individual Mensuration Viewer, Group Projection Viewer, Indexing Rectifier, 8X Enlarger, Contact Duplicator, and Horizon to Nadir Converter. The above mentioned computer services will also be provided. The basic specifications of each equipment and associated tasks are described in later sections. The mensuration viewer, group viewer, contact duplicator and 8X enlarger will be essentially similar to the equipment procured for the 461-L Program. However, the performance of this will be "modified" wherever necessary for compatibility within this program.

A "new" indexing rectifier will be designed for transformation of the cylindrical format projection to a flat perspective. Rectified format duplicates may thus be created for mosaic work in the conventional manner. The indexing rectifier will be designed to accommodate the associated parameters, such as focal length, scan angle, and earth's curvature. It is planned to use a magnification of 1.4X at the nadir in order to most effectively use 5 inch copying film or paper.

The Horizon to Nadir Converter is essential to the program, and will be a new development. The equipment will be semi-automatic in operation, and will be designed to be compatible with horizon format and optics as incorporated in the panoramic camera. The pitch and roll angles will be extracted, and the location of the nadir established. The mensuration capability in both pitch and roll will be better than 1/10 degree. The nadir location will be established in a manner suitable for recording on IBM cards or for insertion into the Alwac Computer as one of the parameters for precision mensuration computation.

Complete geometrical derivations and services will be provided to allow solution of the transformation or rectification equations. These derived equations will recognize and accommodate the expected vehicle motions. They will be reviewed for application in the Using Agency's Alwac Computer, and the required computer programming will be supplied. The various equipments with their operating specifications and required tasks are listed below.

TASK I - INDIVIDUAL MENSURATION VIEWER

Positive Viewing Image, "horizon-up" at 12.2x magnification on 20" x 28" screen. Capacity 500' of 70 millimeter film. Optical Resolution, 100 lines per millimeter. Maximum slewing rate, 250 feet per minute. Minimum slewing rate, 1 foot per minute. Mensuration computer accuracy, 2% not including distortions due to vehicle motions. Operation, semi-automatic.

TASK 2 - GROUP PROJECTION VIEWER

Positive Viewing Image, "horizon-up" at 28x magnification on 48" x 64" screen located approximately 10 feet from projector. Capacity 500' of 70 millimeter film. Optical Resolution, 80 lines per millimeter. Maximum slewing rate, 150 feet per minute. Minimum slewing rate, 1 foot per minute. Operation, remotely controlled, semi-automatic.

TASK 3 - INDEXING RECTIFIER

Cylindrical rectification including recognition of earth's curvature, but not including distortions introduced by vehicle motions. Magnification, 1.4X at nadir. Copy film or paper 5" width. Optical resolution, 15 lines per millimeter. Operation, semi-automatic.

TASK 4 - 8X ENLARGER

Panoramic Enlarger. Capacity, at least 25 1/2 inches of length of the original negative format. Print size, approximately 20" in width by 17 feet long. Optical Resolution, approaches 100 lines per millimeter. Operation, semi-automatic.

TASK 5 - CONTACT DUPLICATOR

Duplication of original 70 millimeter negative on 70 millimeter positive or negative film stock. Exposure Control, automatic for gross dodging. Capacity, 500 feet or greater, negative and copy film. Speed, 10 to 75 feet per minute. Minimum loss in resolution. Operation, semi-automatic.

TASK 6 - TRANSFORMATION COORDINATE STUDY

This task will include the derivation of the basic transformation equations associated with airborne panoramic photography. The study will recognize and include the distortion introduced by pitch, roll, yaw, and forward motion of the vehicle during the panoramic scan. The earth's curvature will also be considered.

The results of this study will be to first provide the Using Agency the basic equations and procedures for extracting ground azimuth and distance information from the panoramic photograph. The second purpose is to provide the basic information for programming a digital computer for automatic extraction of the required information.

TASK 7 - HORIZON TO NADIR CONVERTER

The Horizon to Nadir Converter will be a semi-automatic unit designed to extract the pitch and roll angles from the horizon information existing on the film format.

A preliminary investigation has indicated that the measuring capability of the Converter should be better than 1/10° for the present camera configuration.

Suitable computing elements will be incorporated into the equipment for the establishment of the nadir within the associated film format.

The equipments and services itemized in Tasks I through 7 will allow for complete exploitation, and more important an immediate operating capability can exist in time for the first mission. It is contemplated that "one each" of the Mensuration Viewer (Task I), Group Viewer (Task 2), Indexing Rectifier (Task 3), 8X Enlarger (Task 4), Duplicating Printer (Task 5), and Nadir Computer (Task 7) will be delivered. The Transformation Study (Task 6) is a service that also will be supplied. The attached Cost Proposal is based upon supplying "one-of-each" as described above.

PHASE I I - Study, Design and Prototype Fabrication of a Maximum Capability

The Phase II program will consist of evaluation of the equipment for optimum performance, both individually and as a part of the overall exploitation system. Also additionnal consideration will be given to making all steps as automatic as feasible. This will be done in order to reduce the possibility of errors, allow use of equipment by less-skilled personnel, obtain the inherent information as quickly as possible, and also to increase the flexibility and accuracy of the equipment. In order to accomplish this effort in a satisfactory manner, this Phase will be broken down into two tasks.

TASK I - EQUIPMENT PARAMETER STUDY

The equipment and approaches used to satisfy the immediate needs of Phase I will be reviewed for optimum performance including overall accuracies. The computation techniques will be reviewed for maximum accuracy and reliability. Digital computing techniques will be given serious consideration where analogue techniques have been previously used. The form of the output of each equipment will be reviewed to see that it is compatible with the equipment for which it may serve as an input. By judicious devices of input-output devices (i.e., punch tape, cards, direct digital transmission) and proper control, it appears that various pieces of equipment may be "tied-together" eliminating the operator, and thus improving speed and reliability.

This task will allow time for consideration of the vehicle characteristics as they effect exploitation. Vehicle motions, changes in flight altitude, etc., can now be given proper perspective relative to the operating ranges of the computing elements.

Coincident with this, it will be possible to determine the performance characteristics and design parameters of the High Precision Optical Rectifier. In contrast to the Indexing Rectifier, this instrument will produce a fully rectified cartographic product correcting errors in scanning speed, altitude of the vehicle, "s" distortion, etc.

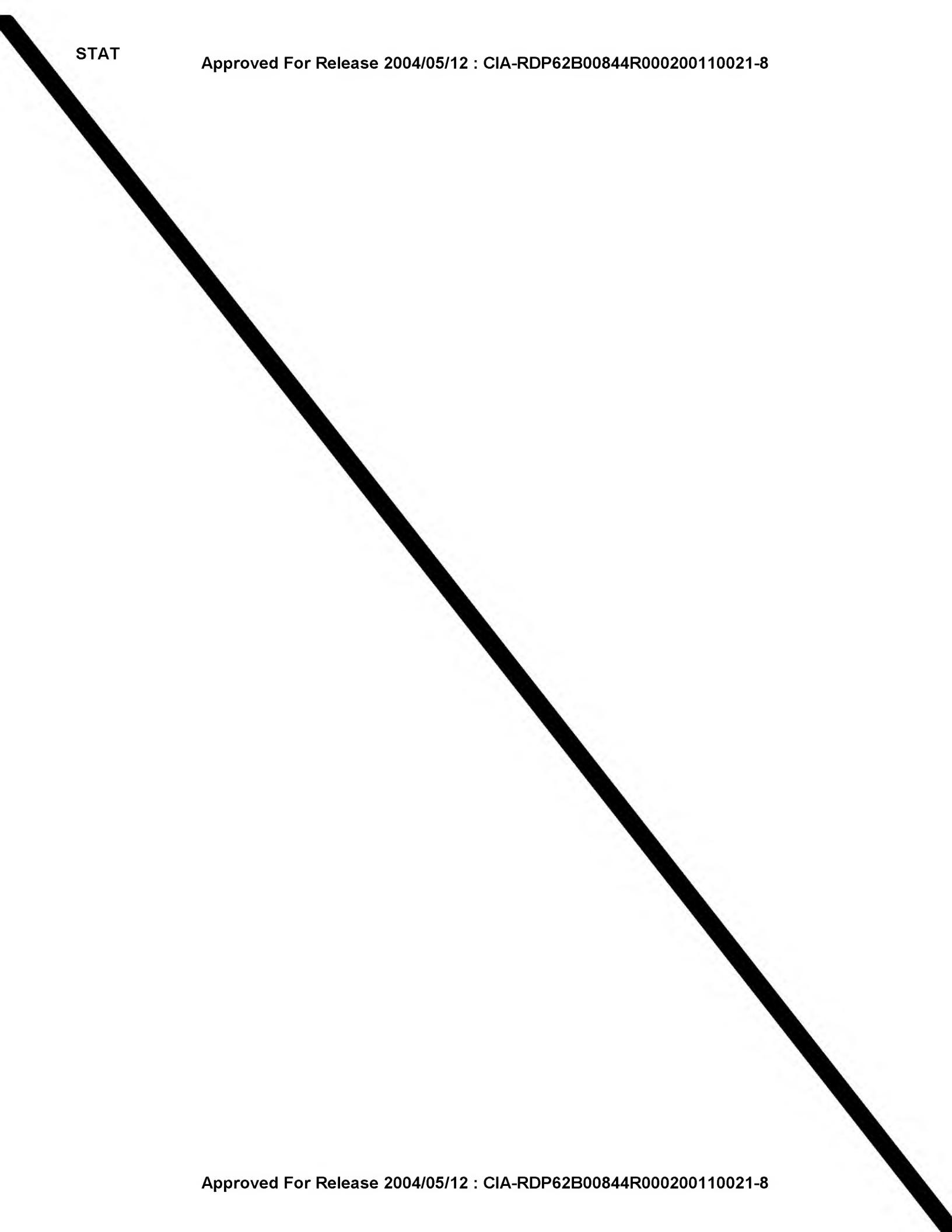
The results of this first task of Phase II should result in the "methods-of-approach" and design parameters for the Phase II equipment. This task should be done concurrent with Phase I and should take approximately four months. This would mean that basic evaluations and approaches will be completed at the time of the first mission. The output of this task should not only apply to this particular program, since its results certainly could serve any other airborne system of a similar nature as the fundamental computations and method of realization are common.

TASK II - DESIGN AND PROTOTYPE FABRICATION

This task will consist of the engineering design and fabrication of equipment to satisfy the maximum exploitation capability. The equipment might consist of modified Phase I equipment, or new designs wherever necessary.

PHASE III - Production of Final Equipment

Preliminary Estimates of the total number of each item of equipment have been made by Itek Personnel and the Using Agency. These estimates will be refined in Task I of Phase II of this proposal. For the budget purposes, these quantities as well as cost and time estimates of production equipment have been included.



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